Space Weather Technical Forecast

Issued on Monday, 20 June 2022 at 13:20 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Active electron fluence. Daily Chance of an isolated M-class flare.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low, with occasional C-class flares observed over the past 24 hours. The largest one of these was a C5.7 at 20/0619 UTC originating from AR3038. This regions is now considered the largest and most complex on the disc, having grown into a Dki/Beta-gamma and it possibly possessed a delta spot for a time. Other moderate C-class flares have also been observed from AR3030 (Eao/Beta-Gamma) near the northwest limb and AR3031 (Cao/Beta) near the southwest limb, although AR3031 has shown signs of decay through the period. There are 3 other regions on the disc, in the western hemisphere, but these remained simple and stable during the period.
No Earth directed CMEs were observed in the available imagery during the period. However, there is a large filament in the northwest quadrant which is being closely monitored for movement.

Solar Wind / Geomagnetic Activity: The solar wind speed, as measured by DSCOVR at L1, has been elevated but erratically declining from around 600 km/s to around 520 Km/s. Density has been steady between 6 and 12 ppcc. The IMF was generally weak (<8 nT), but rose to moderate (8-10 nT) 20/0720-0915 UTC. The north-south weakly fluctuated between +/- 6 nT. The phi angle was initially negative (towards the Sun), but became largely positive (away from the Sun) from 19/1400 UTC. The net result of the above solar wind measures was Quiet to Unsettled (Kp 1-3) geomagnetic activity.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) measured by GOES16 remained at background levels through the period. Electron flux (greater than 2MeV) was generally at Moderate to High levels in the period, with a peak of 2950pfu observed at GOES16 at 19/1735UTC. The corresponding 24-hour integrated electron fluence showed a rising trend, and exceeded the Active (>1e8 integrated pfu) threshold at 20/0000 UTC, with a value of 1.03e8 integrated pfu. It has subsequently risen to 1.23e8 at 20/1200UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be Low, with a daily chance of an isolated M-class flare and slight chance of an X-flare.

Solar Wind / Geomagnetic Activity: No CMEs feature in the forecast. Elevated solar winds are expected to continue their decline on day 1 (20th), but may become elevated or perhaps strong again on Day 2 (21st) under the influence of a small coronal hole, followed by another slow decline on Days 3 and 4 (22nd and 23rd). Geomagnetic activity should reduce from Quiet to Unsettled levels to mainly Quiet. However, there is a chance of Active intervals on days 1 and 2 (20th and 21st) and slight chance of a G1/Minor storm on Day 2 (21st).

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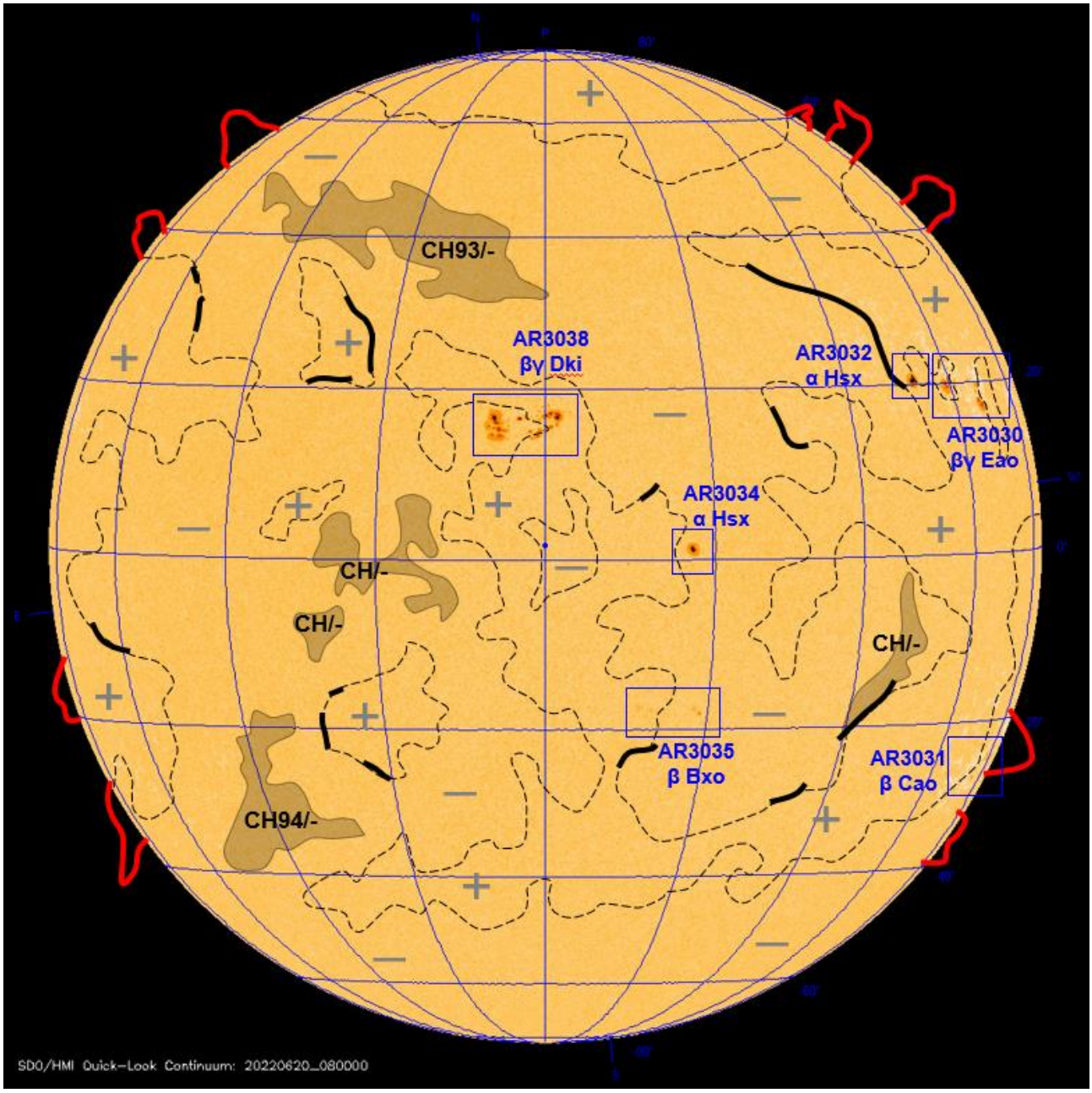
Energetic Particles / Solar Radiation: High energy proton flux (greater than 10 MeV) is expected to be at Background levels during the period, but with a daily Slight Chance of an S1 or greater event occurring, due to the presence of a couple of relatively large and complex regions. The high energy electron flux (greater than 2 MeV) is expected to fluctuate between Moderate to High levels on most days in response to the recent HSS. The 24-hour integrated fluence is likely to remain above the Active threshold (>1e8 integrated pfu), but with confidence reducing throughout the period.

Figure 1. Solar Analysis Valid 20/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No CMEs feature in the forecast.

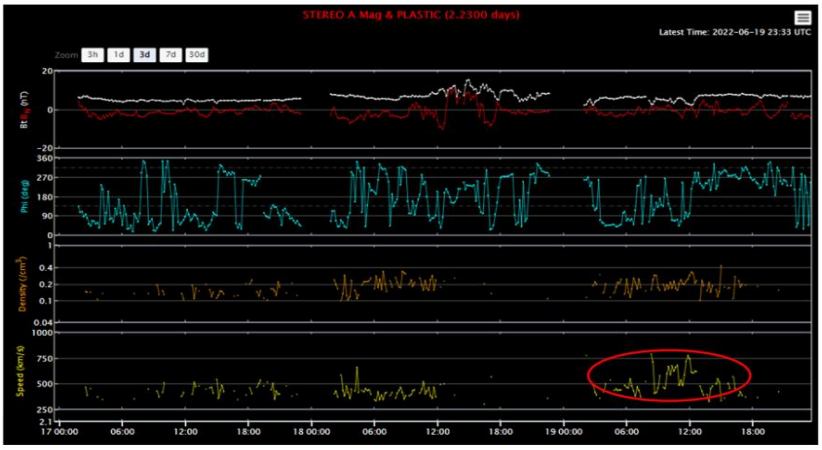
The Earth is now under the waning influence of CH92/+, a feature that is no longer visible, with solar winds expected to continue to decline through day 1 (20th). However, another coronal hole, that was briefly seen facing the Earth on the 17th, may enhance the solar winds on Day 2 (21st). Data obtained from STEREO A MAG and PLASTIC show the solar wind rising to elevated or even strong levels on the 19th, which would also indicate an enhancement at Earth on the 21st. Confidence is low but this would suggest a possible enhancement to the geomagnetic activity, although this should be limited considering the magnetic field remained weak at STEREO.
The next coronal hole likely to affect Earth is CH93/+, which is currently approaching the central meridian. It is a recurrent feature but appears to be further east compared to the previous rotation. As such, the persistence model is considered to increase speeds at Earth too early. The HSS from this feature is more likely to arrive on the 24th, thus beyond the scope of this forecast.
All things considered, geomagnetic activity should reduce from Quiet to Unsettled levels to mainly Quiet. However, there is a chance of Active intervals on days 1 and 2 (20th and 21st) and slight chance of a G1/Minor storm on Day 2 (21st).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	10	1	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: STEREO-A Mag and Plastic data showing solar wind enhancement on the 19th.



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Met Office Space Weather Technical Forecast

Radio Blackouts - X-Ray Flares:

There are presently six sunspot regions on the visible disc. The largest and most complex regions are currently AR3038, near the meridian in the northern hemisphere, and AR3030 near the northwest limb. Both are moderately large and complex, possessing Beta-Gamma formation. AR3031, near the southwest limb, is also noteworthy but is smaller, less complex and has shown signs of decay over the past 24 hours. All other regions are simple and remain stable.

Solar activity was Low over the past 24 hours, with occasional C-class flares originating from the three groups mentioned above. Activity is likely to continue at Low levels, with a daily chance of an isolated M-class flare, and slight chance of an X-flare. AR3030 and AR3038 are the likely sources for this activity.
The large filament on the northwest quadrant is showing signs of instability and will need to be monitored for any lift-off. Some bright flux regions are also visible on STEREO A EUVI195 imagery, around 120 degrees East, suggesting the presence of sunspots regions. These could potentially emerge from the far side over the following days, hence the reason for maintaining the probabilities, despite AR3030 and AR3031 rotating round the west limb to the far side on day 3 (22nd).

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	30	30
Very Active	R3 to R5 X Class	No	5	5	5	5

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at background levels and is expected to remain at this level through the period. However, there is a slight chance of an S1 or greater event in the period. This risk averages to around 5% daily, due to the well spread nature of the larger regions on the disc, and any departing regions should be reinforced by the westward transit of the remaining spots and the potential for returning regions round the east limb.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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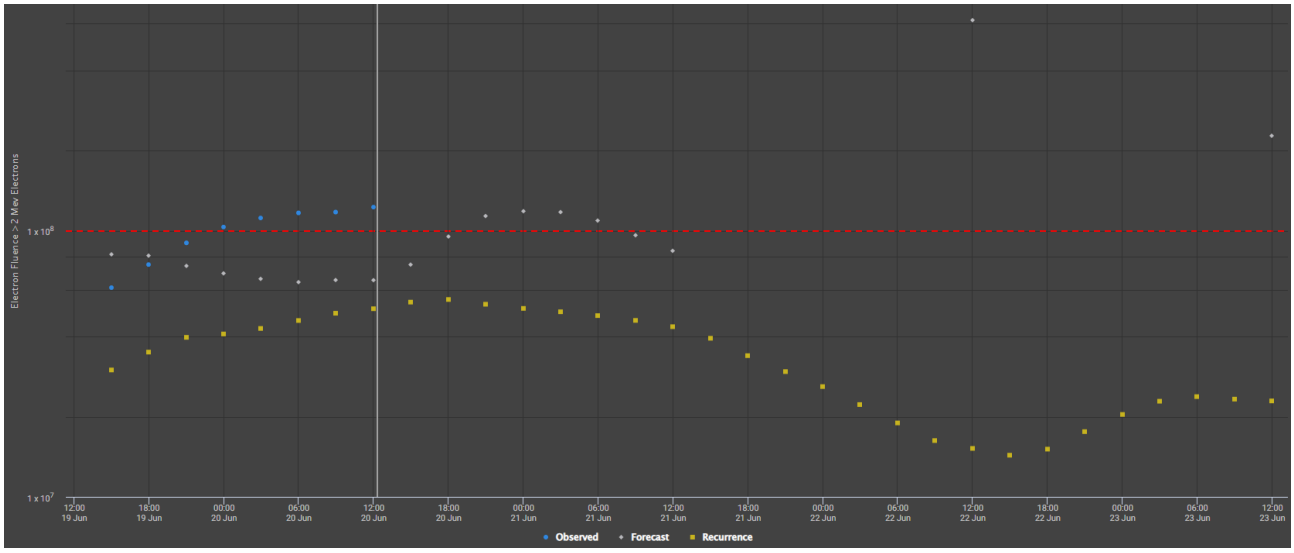
High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV), as observed by GOES16, rose to high levels, peaking at 2950ppcc at 19/1735 UTC, the radiations belts becoming charged following the HSS originating from CH90 and CH92. This pattern should continue over the following days, with the electron flux becoming high during the diurnal peak, but the hypothetical arrival of another HSS on Day 2 may complicate the picture. The electron flux may become suppressed for a time in response to the geomagnetic enhancement but should recover and exceed high levels on Days 3 and 4. However confidence in this feature is low.
The 24-hour integrated fluence is above the Active threshold. It is likely to remain above this threshold throughout much of this period, although this is complicated from day 3 (22nd) onward due to the reasons mentioned above.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	100	90	60	60
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 3: GOES-16 observed electron fluence, plus REFM and persistence data.



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